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THE GREEN SCALE IN SOUTH FLORIDA

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(Continued from Vol. XXVI, No. 1, p. 15)

Five different species of ants have been observed attending green scales for honeydew. Many different species of winged *Diptera* and *Hymenoptera,* which apparently are in search of honeydew, also may be noted on foliage infested with green scales.

NATURAL CONTROL

Control by Insects:

Control of the green scale by insect predators and parasites during the summer and fall months was observed to be practically nil and was considered of little importance.

The twice-stabbed ladybeetle, *Chilocorus bivulnerus* Muls., was seen eating four green scale adults and two other species of ladybeetles were sometimes observed on foliage infested with the scales. Several species of internal dipterous and/or hymenopterous parasites and a predaceous thrips were infrequently encountered during the examination of the green scales. At least two species of mites were often observed mingling with the green scale crawlers and eggs underneath the adult scales, but they did not appear to be harmful to them. Less than 3 percent of all green scales examined were killed by their insect enemies in the summer and fall months.

Control by Fungi:

Several different entomogenous fungi were found associated with the green scales, and some of them apparently played an important role in the natural limitation of the scales on citrus during certain seasons of the year. In their descending order of importance they were:

1. The white-fringed fungus—*Cephalosporium lecanii* Zimm.
2. A grayish blue entomogenous fungus.
3. Cuban aschersonia—*Aschersonia cubensis.*
4. Pink scale fungus—*Nectria diploa* B. & C. sp., perfect stage. *Pseudomicrocera henningsii* (Koorders) Petch, imperfect stage.
5. A secondary fungus, *Fusarium* sp., which might be confused with *C. lecanii.*

Of the various fungi under observation, *Cephalosporium lecanii* Zimm. was the most common and apparently caused the highest percentage of mortality. The next most common fungus, the grayish blue one, also appeared to be very efficient, but it was not nearly so widespread as the *C. lecanii.* Cuban aschersonia was observed in only one grove and there it was only of fractional value in destroying green scales.

The pink scale fungus was of no consequence on green scales. Approximately a dozen specimens of it were found in the thousands of scales examined.

This description of *Cephalosporium lecanii* Zimm. is quoted from a paper[3] given by John Parkin in the Annals of the Royal Botanic Gardens: "The fungus shows itself to the naked eye as a white or pale yellow powdery bloom around and to some extent over the scales. The powdery or mealy appearance is due to inuumerable conidial heads covering the hyphae."

During the early summer months *C. lecanii* was not very plentiful but as the season progressed there was a marked increase in the fungus-infected scales on citrus trees. On June 29 only 2.8 percent of all the scales examined in an unsprayed plot in one grove were dead, and no *C. lecanii* was noted. On August 18, 50 days later, 61.2 percent of all the scales examined on the same plot were dead and 68.3 percent of the dead showed the mycelia of *C. lecanii.* The same trend of increased mortality coincident with an increased abundance of *C. lecanii* was observed in an unsprayed check plot in another grove.

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[3] Fungi parasitic upon Scale—Insects (Coccidae and Aleurodidae): a general account with special reference to Ceylon Forms." Annals of the Royal Botanic Gardens, Peradeniya. Vol. III, Part I, March, 1906.

Through October this fungus was more generally distributed over the trees and the total mortality had increased to 73 percent of the scales examined which indicated that *C. lecanii* was a factor in keeping the infestation in check. Fifty-five percent of all the scales examined at that time showed mycelia of the fungus.

C. lecanii was seldom found associated with green scales on groundsels. It is possible that the open-type growth of these plants does not permit humid conditions sufficiently favorable for the development of the fungus. The fact that *C. lecanii* did not affect green scales on groundsels to any extent may be the reason for the continued heavy infestations on those plants.

Due to the apparent efficiency of *C. lecanii* in limiting green scales on citrus, several attempts were made to artificially spread this fungus on green scales not infected with it on both citrus and groundsels. All attempts to inoculate apparently healthy scales were unsuccessful.

Although *C. lecanii* is a factor in checking green scale infestations, there are several reasons why artificial control may be desirable rather than depending wholly on the fungus to keep infestations in check. If the weather is not suitable for fungus development, the trees may not only become heavily infested with green scales but the leaves will also be coated with sooty mold which provides an excellent breeding place for purple and long scales. Dead green scales that have been killed by *C. lecanii* stick firmly to the leaves. This also affords shelter for purple and long scale crawlers. In short, there might be a satisfactory control of the scales by the fungus, but later an increase of purple and long scales might occur which would cause considerable damage. Consequently several experiments with oil sprays were carried out to determine the effectiveness of oil on the scales and how they might best be controlled.

ARTIFICIAL CONTROL

Control with Oil Sprays:

The green scale was found to be no more difficult to kill than the average scale of the same type. As in all other species of scale insects the crawler and intermediates were found to be the most susceptible to an oil spray and the adults were the most resistant. Citrus and Groundsels were the host plants used in the experimental work.

Concentrations of from 1.0 to 1.7 percent actual oil were tested for their effectiveness on green scales. One application of

1.5 percent oil resulted in satisfactory control, killing on an average 91.2 percent of the scales. The control obtained in plots that received 1.6 and 1.7 percent oil was somewhat better, but there was insufficient difference between the results obtained with the 1.5 percent oil and the two higher concentrations to warrant using either of the latter. Concentrations lower than 1.5 percent, namely, 1.0, 1.12, and 1.33 percent oil, killed a high percentage of the intermediates and crawlers but did not kill a sufficiently high percentage of the adults to consider these lower concentrations as efficient one-application sprays on citrus.

Other experiments were conducted to determine the effectiveness of one application and two applications, respectively, of low concentration oil sprays so that they might be used on tender ornamentals. Six plots sprayed with 1.0 percent oil gave on an average 85.4 percent mortality. A second application of 1.0 per cent oil made on the respective plots from 6 to 42 days after the first spray resulted in a reduction of living scales to 3.3 percent which is considered satisfactory control. In one plot, prior to an oil spray, the stages of the scales were found to be in the following proportionate percentages: 10 percent adults, 30 percent crawlers, and 60 percent intermediates. Three days after the spray was applied counts showed that of the small percentage of scales remaining, 29 percent were adults, 65 percent were crawlers, and 6 percent were intermediates. The proportionate percentage of increase of crawlers was due to the fact that, in weaker oil concentrations, the adults that were not killed continued to deposit eggs. This accounts for the high percentage of crawlers in the postspray count.

In one series of plots where a satisfactory control did not result from the 1.5 percent oil, a second application of 1.0 percent oil reduced the population to the minimum. In one of these plots only 70 percent control was obtained from a 1.5 percent oil. A second application of 1.0 percent oil made 10 days after the first spray killed all but 2 percent.

Results of a count made from leaves picked at random from 6 plots after the second application of a 1.0 percent oil showed a population of .1 living scale per leaf which demonstrated that the population was reduced to a minimum. Since all of the second applications were made within a period of 6 weeks after the first spray, none of the progeny of the females which survived the first spray had time to mature. Probably the most satisfactory results from two applications may be obtained if the second

spray is applied from 4 to 5 weeks after the first spray. All females surviving the first spray will be given time to complete oviposition so that all the young hatched may be killed by the second application of oil.

The citrus trees in all plots were in good healthy condition and there was no noticeable injury on citrus from any of the concentration sprays even where the percentage of oil was as high as 1.7. No burn resulted from any of the oil timing sprays even when the 1.5 percent oil was followed in 7 days with 1.0 percent oil. Although no injury resulted from the oil timing sprays, the second application should be applied *only* in case of emergency.

Prevention:

Indications are that green scales may leave groundsels to infest adjacent citrus trees if these plants occur around or near a grove. On the west end of one grove where groundsels were the most abundant and where the heaviest infestations of scales occurred on them, citrus trees were correspondingly infested. As the number of heavily infested groundsels decreased, there was also a decrease in the number of infested citrus trees, and where there were fewer groundsels with no infestations, the citrus trees were apparently also free of scale.

With this in mind the possibility of a grove becoming infested may be reduced by destroying all groundsels around or near citrus groves, especially those bordering young citrus plantings.

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DRAGONFLIES COLLECTED IN THE VICINITY OF FLORALA, ALABAMA [1]

By MIKE WRIGHT [2]

The dragon flies discussed herein were collected by the writer in the vicinity of Florala, Ala., from April 29 through May 26, 1942. The publishing of these notes, even though they are fragmentary, was deemed advisable because of the absolute lack of dragonfly record from this locale.

Florala is in Covington County, Ala., and its southern limits are but a short distance from the Florida-Alabama State line. The collecting was done within a 10-mile radius of Florala and the localities visited are briefly described below.

1. **Lake Jackson.**—A small lake at the south end of Florala, lying half in Alabama and half in Florida. Its shores are marshy and in places heavily wooded. In some places the marshy areas are replaced by standing water, which affords excellent breeding habitats for *Lestes, Plathemis,* and other marsh-loving forms.

2. **Svea.**—A small settlement about 8 miles southwest of Florala, in Okaloosa County, Fla. There were several small creeks and "bay heads" in the area in which dragon flies were found.

3. **Lockhart.**—A small sawmill settlement in Covington County, Ala., about 2 miles northwest of Florala. Streams, "bay heads," and the sawmill pond and stream afforded habitats for odonate breeding.

4. **Pond Creek.**—A typical creek of this area, which meandered through the countryside and, owing to erosion, had produced a noticeable valley. The borders of the stream were in general heavily wooded and gave way, in many places, to swampy or marshy areas. Pond Creek was about 4 miles south and west of Florala.

5. **Flemming Creek.**—Similar to Pond Creek and located about 6 miles southwest of Florala.

6. **Natural Bridge Creek.**—Located in Walton County, Fla., about 8 miles east of Florala. A very interesting stream that, in the area studied, disappeared several times beneath the ground, leaving a series of pools. It had a series of riffles and

[1] United States Department of Agriculture, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine.

[2] The writer wishes to express his sincere appreciation to Dr. Lyman S. Henderson, at that time connected with the white-fringed beetle laboratory at Florala, for his kindness in personally taking the writer to all of the above-mentioned collection areas. Without the direction of Dr. Henderson many of the species listed herein would not have been found.

wide sandy shores which, in places, were covered by shrubs 8 to 10 feet high. Behind these was a heavily wooded area which gave way to grasslands.

7. **Pond A.**—In Walton County, Fla., about 6 miles east of Florala, an open woodland pond exhibiting considerable fluctuation of water level. A thin fringe of trees around the edge gave way to open grassy fields. Few or no emergent or true aquatic plants were present.

8. **Pond B.**—About 2 miles south of Florala, in Walton County, Fla., was a beautiful pond completely hidden in the middle of a densely wooded area. The trees came almost to the edge of the water, leaving a narrow sandy beach. The pond was filled with emergent and submerged plants. Many dragonflies, including our first specimens of *Teleallagma daeckii*, were seen or collected at this pond. A study of the odonate fauna of the pond during the entire summer would undoubtedly show several times the number of species taken during our study.[1]

NOTES ON THE SPECIES OF ODONATA FOUND

1. *Agrion dimidiatum* (Burmeister). Pond Creek, May 3, 1942; Natural Bridge Creek, May 16, 1942; Pond Creek, May 23, 1942. This is a beautiful insect and inhabits the same general habitat type as *A. maculatum* Beauvois. Both species prefer a freely flowing and usually heavily shaded brook or stream. At Pond Creek hundreds of individuals were observed under the highway bridge crossing the creek. When disturbed they flew out into the open, but soon returned to the shaded portion of the creek. In all our collecting of this species, as well as *A. maculatum*, we have never taken individuals at any great distance from the water. They are not swift flyers but do considerable moving, usually up and down the stream, and perch at frequent intervals on the waterside vegetation. At the time of collecting at Pond Creek (in May) there were probably from 6 to 8 times as many males as females; in fact, we had to hunt for a long time before a female was flushed.

In the several years that I have been collecting Odonata in the Gulf coast area of Louisiana, Mississippi, and Alabama I have taken this species but once before, in Baldwin County, Ala. Throughout the central Gulf coastal area *Agrion maculatum* is encountered in practically all shaded, flowing streams. We have never found both species inhabiting the same creek. At Pond Creek and Natural Bridge Creek, in the Florala area, *A. dimidiatum* was found in considerable numbers but *A. maculatum* was not taken by us in the entire Florala area. Likewise at Rocky Creek, in Baldwin County, Ala., *A. dimidiatum* was very abundant, while *A. maculatum* was entirely absent. The converse holds for those streams along which we have taken *A. maculatum*. In Baldwin County, Ala., we took *A. maculatum* along a creek a few miles distant from Rocky Creek, but were able to find only one species at each creek. We are unable to explain this peculiarity, because the creeks inhabited by both species appeared identical to us. Ecological analyses of such streams might show chemical or physical differences not apparent to the collector. Whatever these effects, each species becomes the dominant dragonfly in the stream inhabited by it. (To be continued)

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